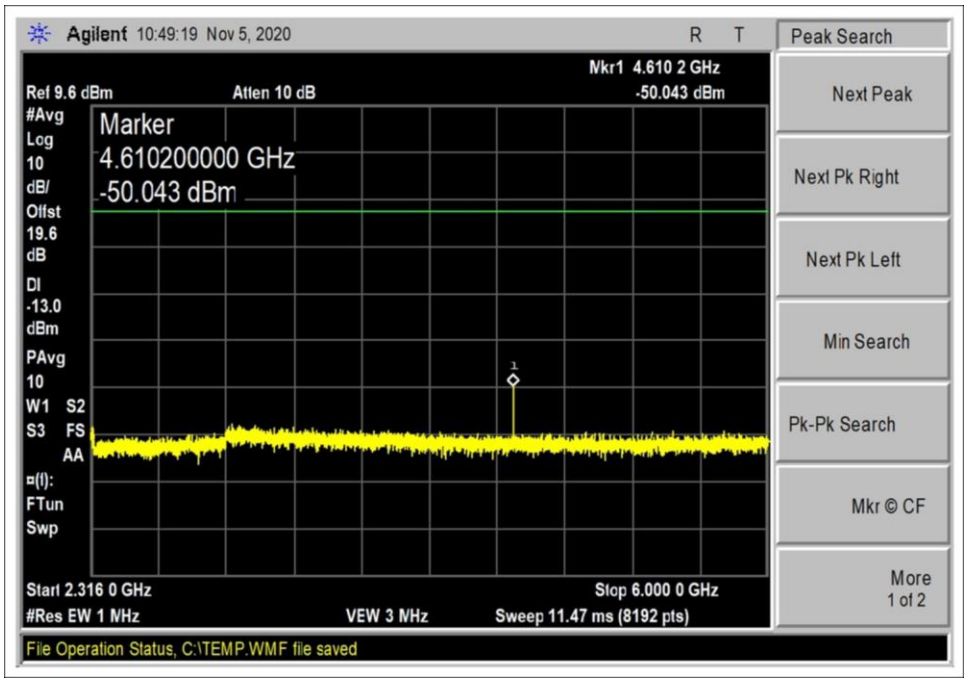
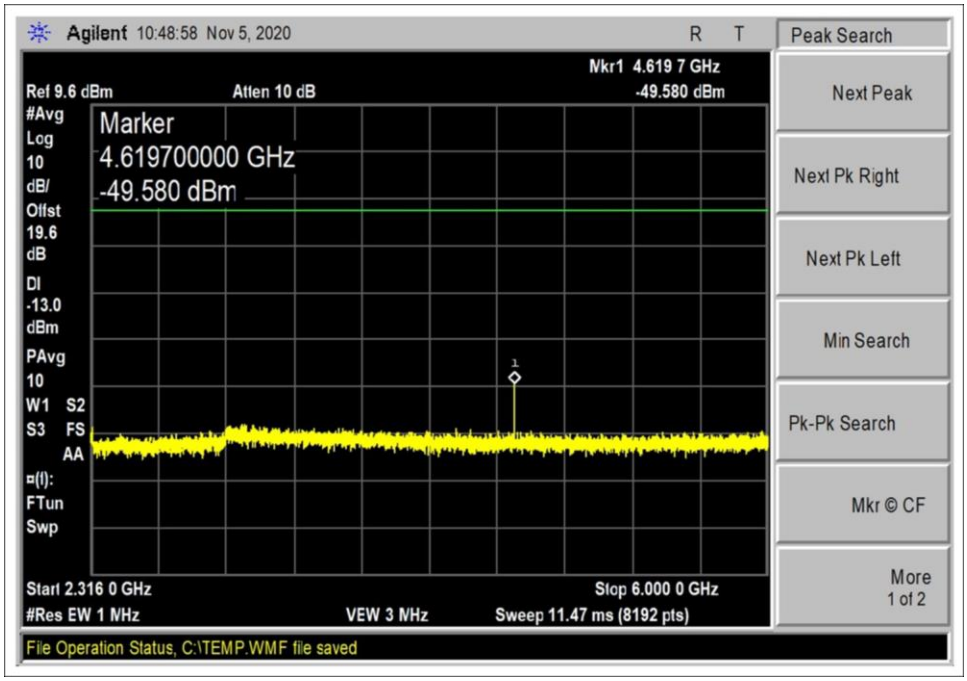


UL 2305-2315_Low CH_2316M-6G



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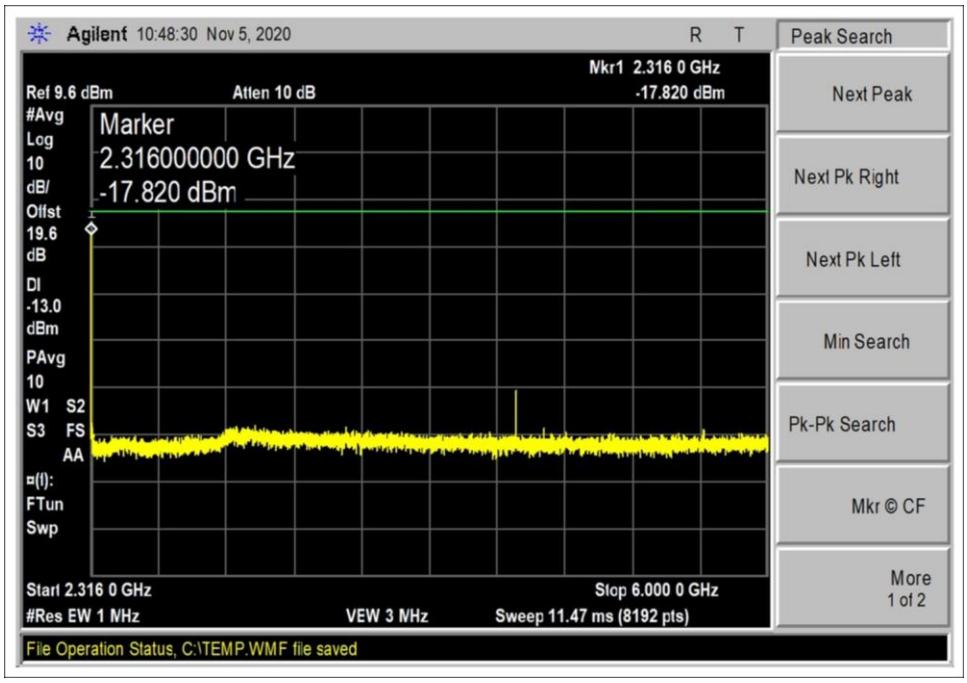

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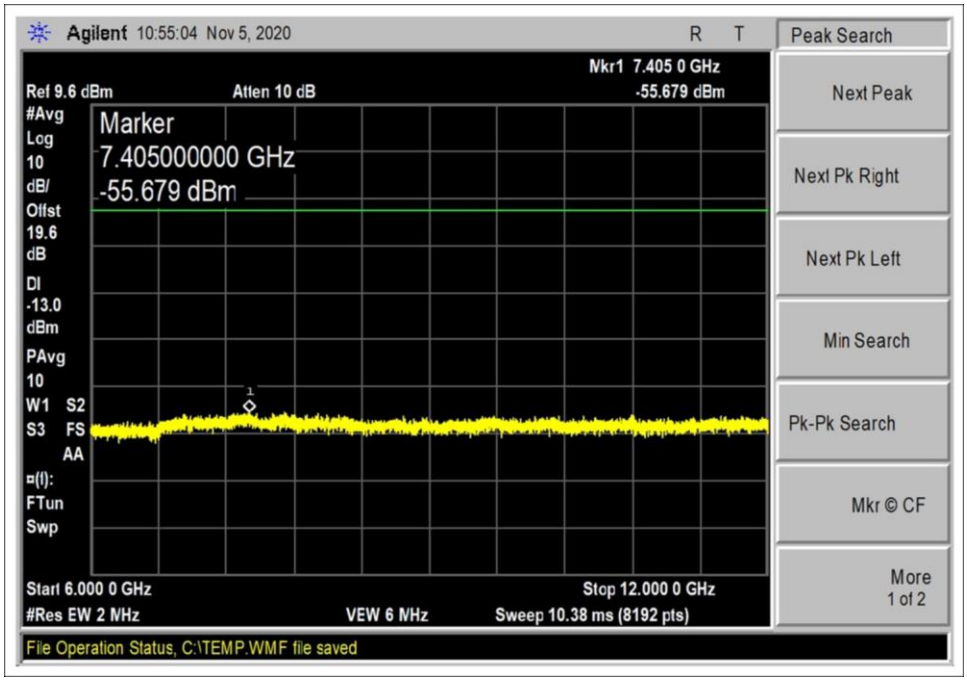

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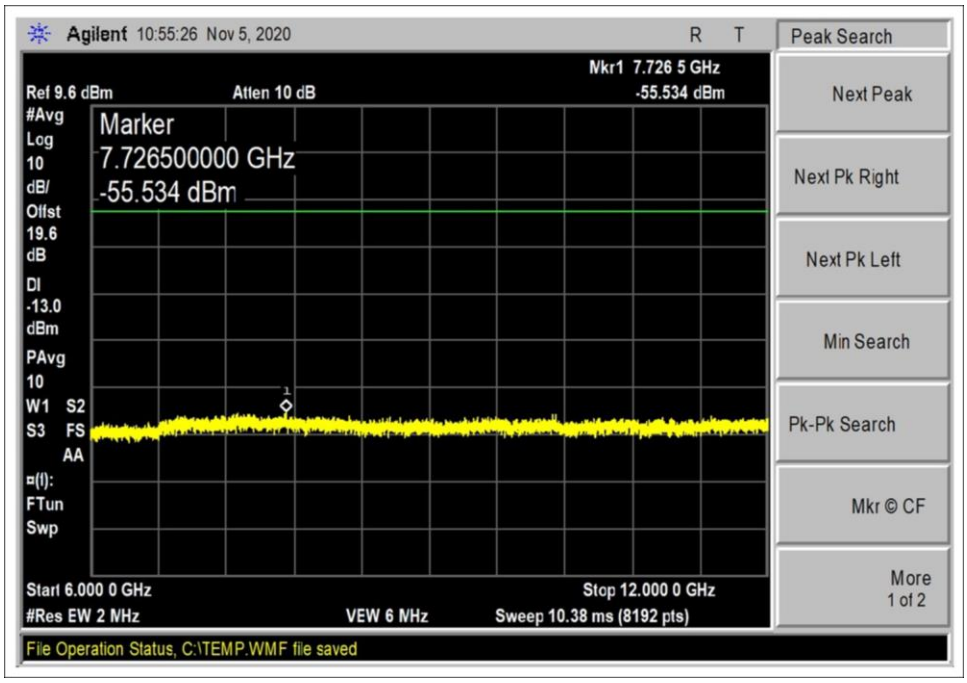

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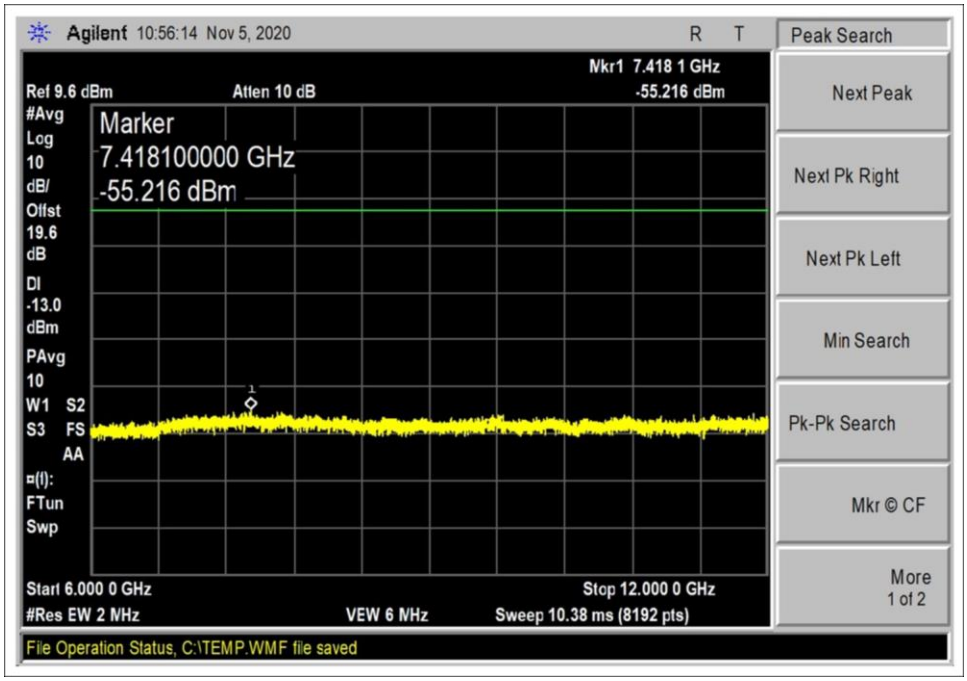

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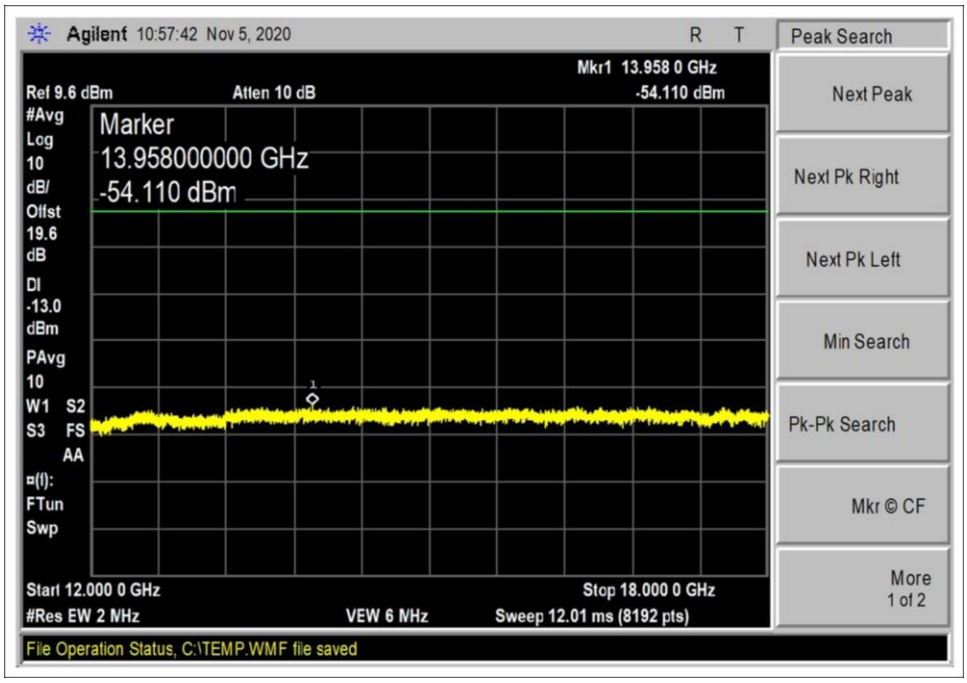
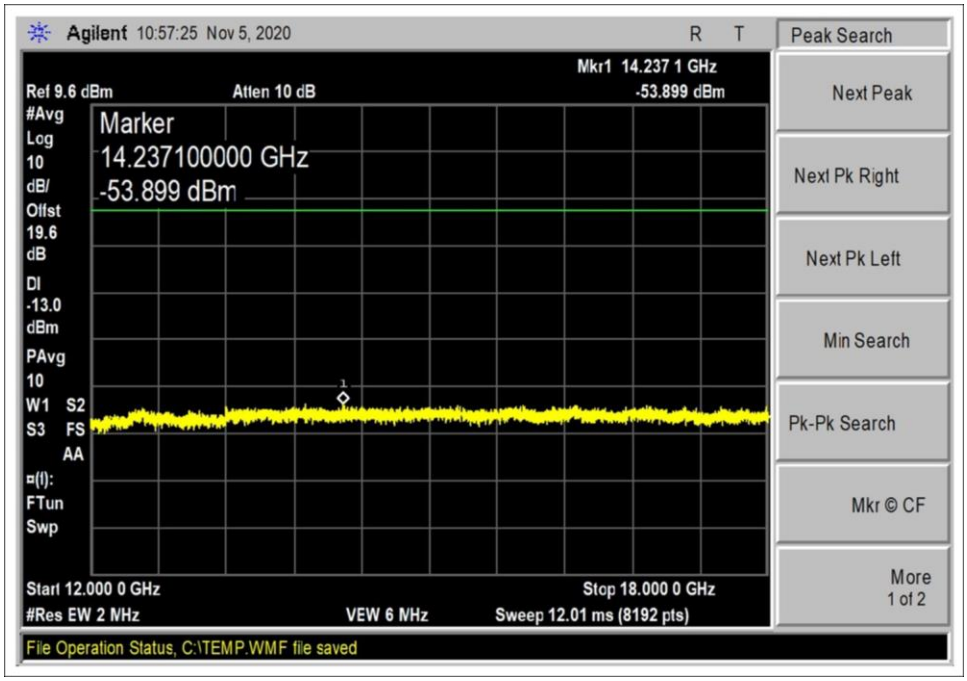
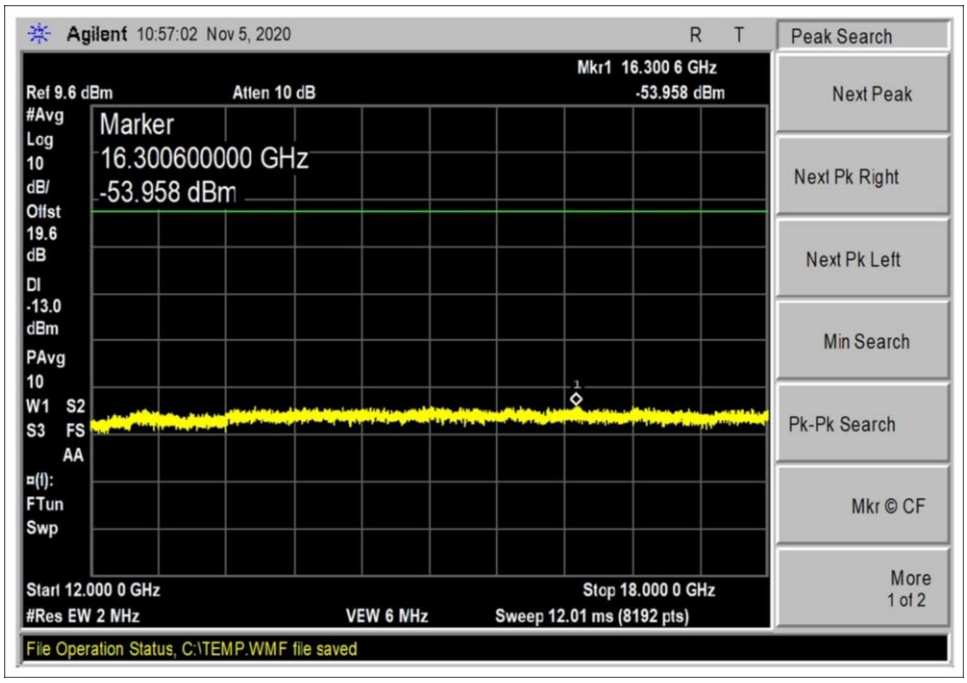


UL 2305-2315_Low CH 12G-18G



UL 2305-2315_Middle CH 12G-18G



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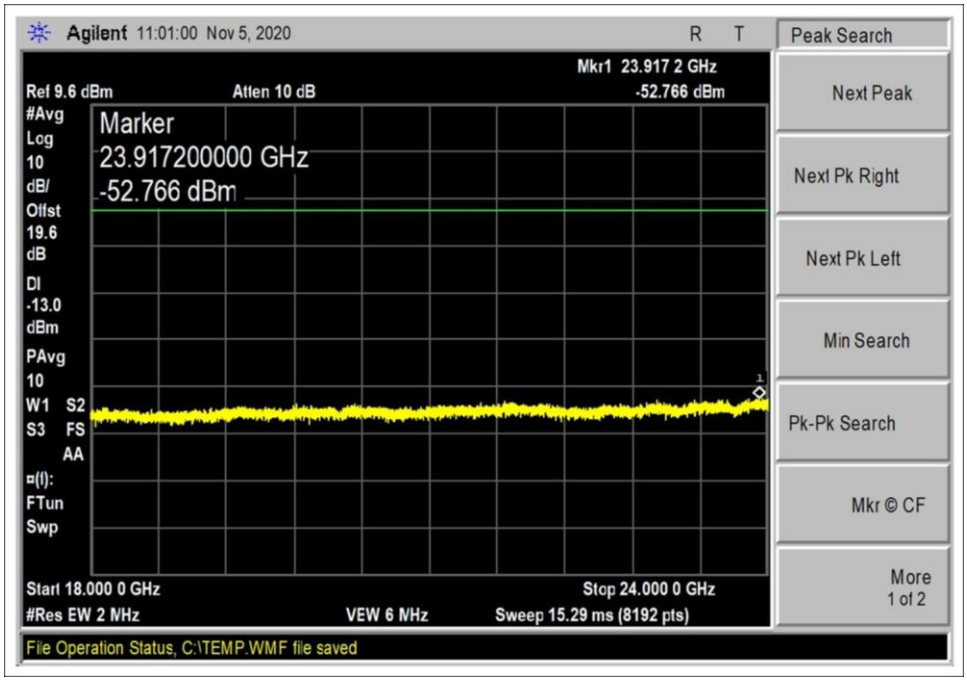
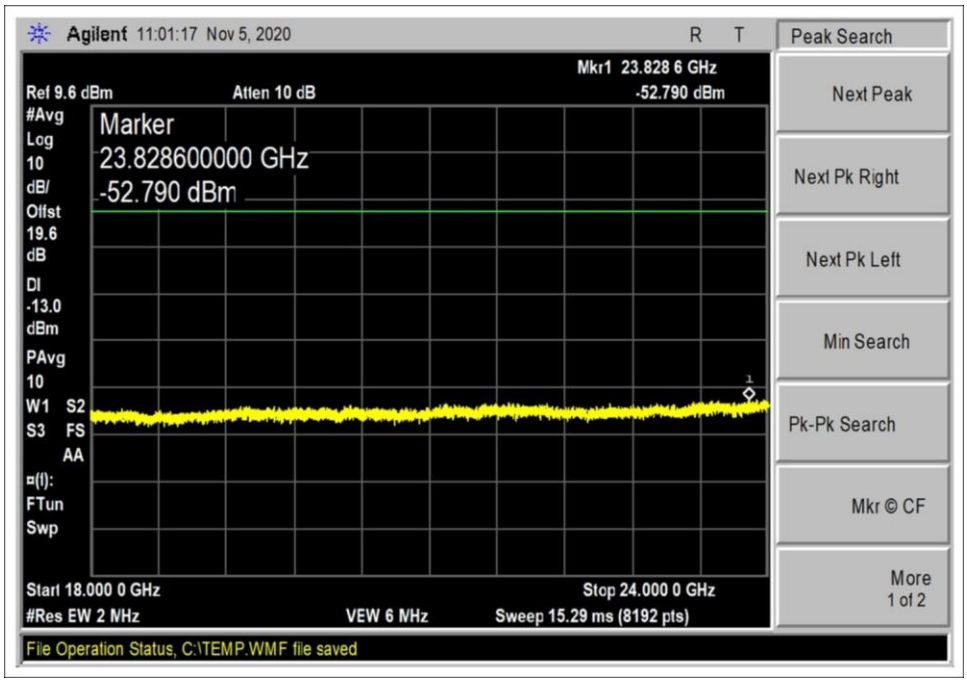
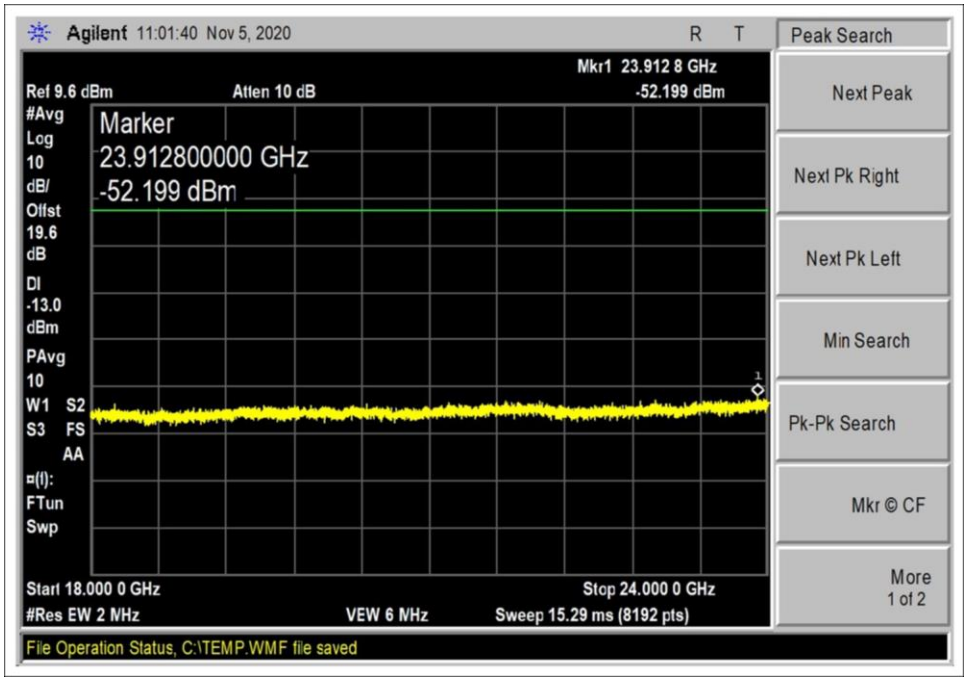


UL 2305-2315_Low CH 18G-24G



UL 2305-2315_Middle CH 18G-24G



UL 2305-2315_High CH 18G-24G

3.8 Radiated Spurious Emissions

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA • 714 993 6112		
Customer:	**Optical Zonu**		
Specification:	**47 CFR §20.21, 22H, 24E, 27, 27D, 27L, 90S Spurious Emissions**		
Work Order #:	**104362**	Date:	11/6/2020
Test Type:	**Maximized Emissions**	Time:	12:59:39
Tested By:	Don Nguyen	Sequence#:	4
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUTs (Antenna and Equipment units) are placed on tabletop and connected to 12Vdc and 48Vdc external power supplies. Input port is connected to a signal generator. Output port (Antenna) is terminated with 50ohm load. Uplink (Equipment) unit and Downlink (Antenna) Unit are connected via an unshielded optical cable.

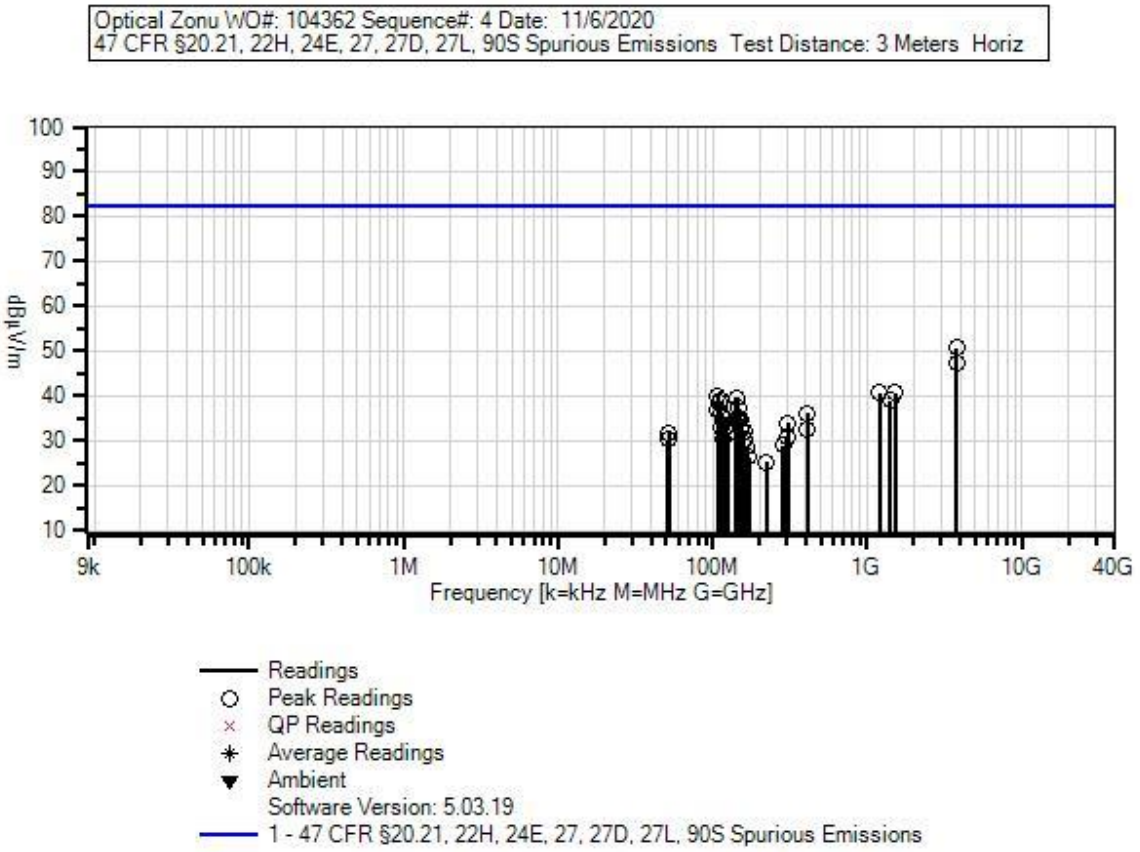
Operating frequency band (MHz)

UL: 698-716	776-787	817-824	824-849	1850-1915	1710-1755	2305-2315
DL: 728- 746	746-757	862-869	869-894	1930-1995	2100-2155	2350-2360

Operation mode
Active output: Uplink
Worst case frequency band with highest power: UL 1850-1915
Signal Protocol: GSM and AWGN
Data represents the worst case configuration.

The manufacturer declares that the highest operating frequency of the EUT is 2.360GHz.

Frequency range of measurement = 9kHz-24GHz
9kHz to 150kHz RBW=0.2kHz, VBW=0.6kHz.
150kHz to 30MHz RBW=9kHz, VBW=27kHz.
30-1000MHz, RBW=120kHz, VBW=360kHz
1-24GHz, RBW=1MHz, VBW=3MHz



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN00309	Preamp	8447D	12/24/2019	12/24/2021
T2	ANP05281	Attenuator	1B	4/7/2020	4/7/2022
T3	ANP05050	Cable	RG223/U	12/24/2018	12/24/2020
T4	ANP05198	Cable-Amplitude +15C to +45C (dB)	8268	12/4/2018	12/4/2020
T5	AN01993	Biconilog Antenna	CBL6111C	6/11/2019	6/11/2021
	AN03643	Spectrum Analyzer	E4440A	5/20/2020	5/20/2022
T6	AN00786	Preamp	83017A	5/20/2020	5/20/2022
T7	AN00849	Horn Antenna	3115	3/17/2020	3/17/2022
T8	ANP06360	Cable	L1-PNMNM-48	8/8/2019	8/8/2021
T9	ANP07243	Cable	32022-29094K-29094K-24TC	5/29/2020	5/29/2022
	AN03367	Horn Antenna	62-GH-62-25.	8/1/2019	8/1/2021
	AN00314	Loop Antenna	6502	4/13/2020	4/13/2022
	AN01413	Horn Antenna	84125-80008	10/19/2020	10/19/2022

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	3765.460M	51.8	+0.0 +0.0 +0.5	+0.0 -38.0	+0.0 +32.4	+0.0 +4.0	+0.0	50.7	82.2	-31.5	Vert
2	3764.960M	48.5	+0.0 +0.0 +0.5	+0.0 -38.0	+0.0 +32.4	+0.0 +4.0	+0.0	47.4	82.2	-34.8	Horiz
3	1205.920M	52.7	+0.0 +0.0 +0.4	+0.0 -39.9	+0.0 +25.3	+0.0 +2.2	+0.0	40.7	82.2	-41.5	Vert
4	1507.420M	51.2	+0.0 +0.0 +0.4	+0.0 -39.1	+0.0 +25.7	+0.0 +2.5	+0.0	40.7	82.2	-41.5	Horiz
5	108.207M	49.6	-28.0 +10.5 +0.0	+5.9 +0.0	+0.1 +0.0	+1.8 +0.0	+0.0	39.9	82.2	-42.3	Vert
6	143.680M	48.2	-28.0 +11.3 +0.0	+5.9 +0.0	+0.2 +0.0	+2.1 +0.0	+0.0	39.7	82.2	-42.5	Horiz
7	142.680M	48.1	-28.0 +11.3 +0.0	+5.9 +0.0	+0.2 +0.0	+2.1 +0.0	+0.0	39.6	82.2	-42.6	Horiz
8	1407.420M	49.7	+0.0 +0.0 +0.4	+0.0 -39.3	+0.0 +25.6	+0.0 +2.5	+0.0	38.9	82.2	-43.3	Vert
9	112.157M	48.2	-28.0 +10.8 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	38.9	82.2	-43.3	Vert
10	108.557M	48.4	-28.0 +10.5 +0.0	+5.9 +0.0	+0.1 +0.0	+1.8 +0.0	+0.0	38.7	82.2	-43.5	Vert
11	147.950M	45.7	-28.0 +11.2 +0.0	+5.9 +0.0	+0.2 +0.0	+2.2 +0.0	+0.0	37.2	82.2	-45.0	Vert
12	108.292M	46.7	-28.0 +10.5 +0.0	+5.9 +0.0	+0.1 +0.0	+1.8 +0.0	+0.0	37.0	82.2	-45.2	Horiz
13	114.757M	45.3	-28.0 +10.9 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	36.1	82.2	-46.1	Vert
14	408.130M	37.6	-27.9 +16.3 +0.0	+5.9 +0.0	+0.3 +0.0	+3.8 +0.0	+0.0	36.0	82.2	-46.2	Horiz
15	118.007M	44.3	-28.0 +11.1 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	35.3	82.2	-46.9	Vert

16	117.007M	44.0	-28.0 +11.0 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	34.9	82.2	-47.3	Vert
17	151.850M	43.5	-28.0 +11.1 +0.0	+5.9 +0.0	+0.2 +0.0	+2.2 +0.0	+0.0	34.9	82.2	-47.3	Vert
18	143.380M	43.3	-28.0 +11.3 +0.0	+5.9 +0.0	+0.2 +0.0	+2.1 +0.0	+0.0	34.8	82.2	-47.4	Horiz
19	145.980M	42.9	-28.0 +11.3 +0.0	+5.9 +0.0	+0.2 +0.0	+2.2 +0.0	+0.0	34.5	82.2	-47.7	Horiz
20	306.130M	39.0	-27.9 +13.5 +0.0	+5.9 +0.0	+0.3 +0.0	+3.2 +0.0	+0.0	34.0	82.2	-48.2	Horiz
21	112.780M	42.4	-28.0 +10.8 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	33.1	82.2	-49.1	Horiz
22	120.557M	41.9	-28.0 +11.2 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	33.0	82.2	-49.2	Vert
23	408.130M	34.2	-27.9 +16.3 +0.0	+5.9 +0.0	+0.3 +0.0	+3.8 +0.0	+0.0	32.6	82.2	-49.6	Horiz
24	149.280M	40.9	-28.0 +11.2 +0.0	+5.9 +0.0	+0.2 +0.0	+2.2 +0.0	+0.0	32.4	82.2	-49.8	Horiz
25	159.280M	41.2	-28.0 +10.6 +0.0	+5.9 +0.0	+0.2 +0.0	+2.3 +0.0	+0.0	32.2	82.2	-50.0	Horiz
26	52.380M	44.2	-28.1 +8.5 +0.0	+5.9 +0.0	+0.1 +0.0	+1.3 +0.0	+0.0	31.9	82.2	-50.3	Horiz
27	126.457M	40.5	-28.0 +11.3 +0.0	+5.9 +0.0	+0.1 +0.0	+2.0 +0.0	+0.0	31.8	82.2	-50.4	Vert
28	302.130M	35.7	-27.9 +13.4 +0.0	+5.9 +0.0	+0.3 +0.0	+3.2 +0.0	+0.0	30.6	82.2	-51.6	Horiz
29	117.680M	39.5	-28.0 +11.1 +0.0	+5.9 +0.0	+0.1 +0.0	+1.9 +0.0	+0.0	30.5	82.2	-51.7	Horiz
30	158.950M	39.4	-28.0 +10.7 +0.0	+5.9 +0.0	+0.2 +0.0	+2.3 +0.0	+0.0	30.5	82.2	-51.7	Vert
31	51.680M	42.4	-28.1 +8.7 +0.0	+5.9 +0.0	+0.1 +0.0	+1.2 +0.0	+0.0	30.2	82.2	-52.0	Horiz
32	285.660M	34.4	-27.9 +13.0 +0.0	+5.9 +0.0	+0.3 +0.0	+3.1 +0.0	+0.0	28.8	82.2	-53.4	Horiz

33	167.450M	38.3	-28.0 +10.0 +0.0	+5.9 +0.0	+0.2 +0.0	+2.4 +0.0	+0.0	28.8	82.2	-53.4	Vert
34	171.650M	36.0	-28.0 +9.7 +0.0	+5.9 +0.0	+0.2 +0.0	+2.4 +0.0	+0.0	26.2	82.2	-56.0	Vert
35	221.550M	33.8	-27.9 +10.5 +0.0	+5.9 +0.0	+0.2 +0.0	+2.7 +0.0	+0.0	25.2	82.2	-57.0	Vert

Limit Line For Spurious Radiated Emission

REQUIRED ATTENUATION = 43+10 LOG P DB

Limit = Power - Required Attenuation
= 10 Log P – (43 +10Log P)
= ~~10Log P~~ – 43 – ~~10Log P~~
= -43 dBW
= 0.00005W (0.05mW)
= 10 Log 0.00005/0.001
= -13dBm at any power level.

ANSI 63.26 (2015) clause 5.2.7

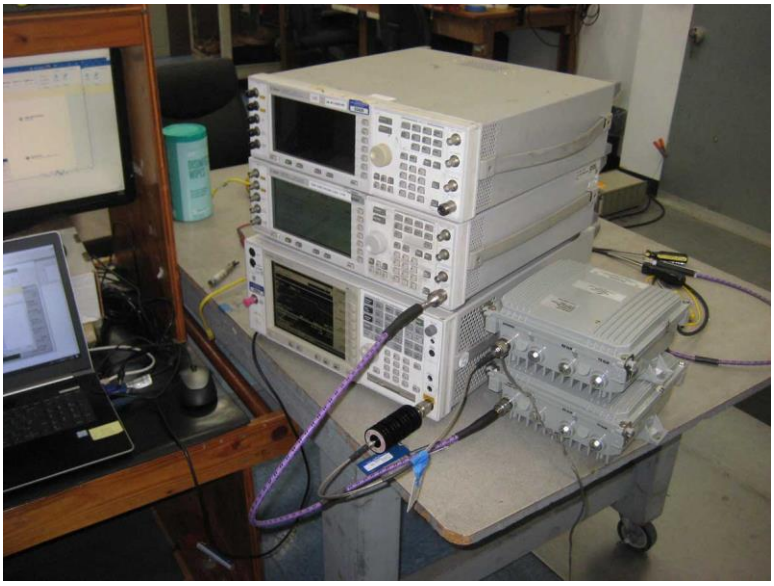
E (dBµV/m) = EIRP (dBm) – 20log(D) + 104.8

where D is the measurement distance (in the far field region) in m.

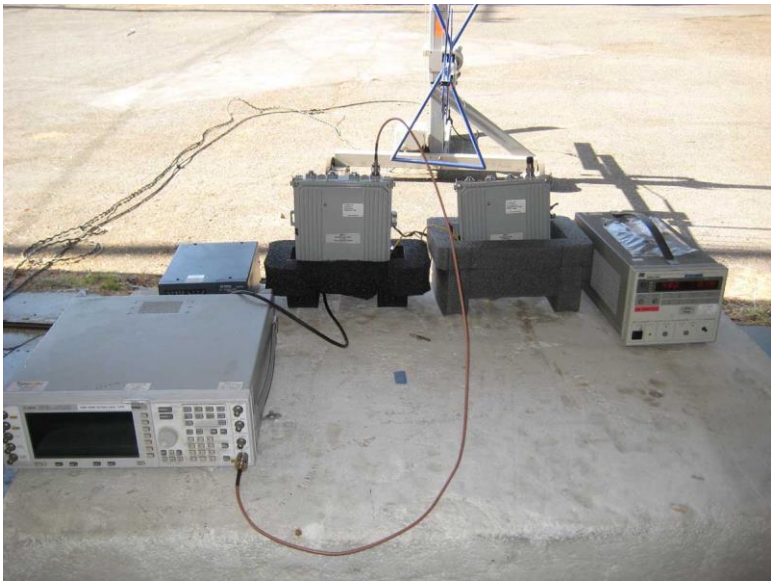
Radiated Emission limit @ 3 meter = -13dBm-20Log (3) +104.8

= 82.2 dBuV/m (-24.8dBm/m)@3m at any power level

Exhibit A: Test Setup Photos



Section 3.3, 3.4, 3.5, 3.6.2, and 3.6.3 Test Setup



Section 3.8 Below 1GHz

Section 3.8 Below 1GHz

Section 3.8 Above 1GHz

Section 3.8 Above 1GHz

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret (“^”) was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.